PROJECT REPORT

MScFE Capstone Project

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1. Abstract

In this project we analyze consistency of sustainability scores, supplied by two different data providers (Datastream and Sustainalytics) during the period beginning December 2009 and ending in December 2017. Additionally, we explore the impact of applying an additional, sustainability scores based, filter to stock universes of USA and Europe. This filter is based on different sustainability measures provided by Datastream and covering period from December 2002 to December 2017.

The main aim of our project is to determine whether a Sustainable investing strategy leads to underperformance in the USA market (S&P 500) and the European market (Stoxx Europe 600). To discover this, first we split all companies into clusters based on sustainability scores and form corresponding portfolios. Subsequenty, we analyze the strategy performance during June 2003 - May 2018 in terms of the number of indicators, such as: average annual return, standard deviation, Sharpe ratio and cumulative return. Moreover, we compute Market Beta, Bull and Bear Market Betas, Size, Value and Momentum characteristics. Finally, we summarize all the findings and answer our main "underperformance" question.

The scores consistency, strategy development, all the calculations and visualization are performed using R - a language and environment for statistical computing and graphics.

2. Introduction

Nowadays sustainable investment is a hot topic. More and more investors do not want to support weapons manufacturers and other companies, exploiting human weaknesses. The new trend towards making the world a better place forces portfolio managers to investigate Socially Responsible Investing (SRI) and take into account new requirements of investors. However, risk-adjusted returns, as a performance indicator, still play the most significant role. With this in mind, researchers must answer how sustainable investing influence performance.

There are three possible outcomes in terms of performance effect: positive (increase), negative (decrease) and neutral (no change). To make the research unbiased, we took into account research projects, which support different points of view. Our Literature review showed that currently there is still no consensus whether responsible investing is a good bet for investors or not. The "Optimists" camp showed that excluding The worst (in terms of ESG scores) 10%-25% stocks leads to outperformance and does not harm diversification [25]. The "Neutral" camp, in their turn, are not so optimistic and just argue that there is no difference in alphas between "ESG winners" portfolio and "ESG losers" portfolio [9]. From the opposite site, the "Pessimists" camp claim that investors, who use ESG strategies, are exposed to average losses of around 40.6% annually in risk-adjusted returns. Moreover, they also argue that the underperformance is robust against different model specifications and test assets [7].

However, there is one potential reason for such different results. There are several independent sustainability scores data providers, which could provide different scores. Furthermore, many researchers in their papers used rather short time periods, obviously, making all the findings

less reliable. In our research we would like to check the hypothesis of this difference in sustainability, expand the research time and answer the main question: "Does investment into sustainable companies lower the overall portfolio performance or not?" These answers will let investors to make to sophisticated investment decisions.

To answer the question properly, we specify the problem more precisely, adding two additional questions. The first question reflects sustainability scores consistency, while the second one addresses the robustness of results in terms of different stock markets.

Such formulation leads us to the next set of objectives:

1. Analyze consistency of the sustainability scores provided by different data suppliers for American and European markets.
2. Splitting all companies into clusters based on sustainability scores and forming corresponding portfolios, determine whether "Sustainable investing strategy" leads to underperformance in USA market.
3. Check the strategy performance also for European market and make a conclusion about the robustness of results.

3. Theoretical Framework

To make the research unbiased, we need to take into account research projects, which support different points of view. For this purpose, we decided to split related literature into three groups: papers, which support positive influence of Socially Responsible Investment (SRI), ones, which conclude that effect is negative, and, finally, papers stating that there is no significant effect on portfolio performance.

Camp "Optimists"

Starting from optimistic point of view, we analysed work of Tim Verheyden, Robert G. Eccles, and Andreas Feiner "ESG for All? The Impact of ESG Screening on Return, Risk, and Diversification", published in 2016 in Journal of Applied Corporate Finance [25]. The analysis was conducted on the six years of available data between 2010 and 2015.

Two investment universes were defined:

- "Global All" including large and mid-cap stocks in 23 developed and 23 emerging markets
- "Global Developed Markets (DM)" including large and mid-cap stocks in 23 developed countries

3 different ESG criteria were used:

- Best-in-class ESG score. Using data provided by Sustainalytics, two ESG-screened portfolios were created by excluding, first, the companies in the bottom 10% of ESG rankings (relative to their competitors) and then the bottom 25%
- United Nations Global Compact (Global Compact) compliance. Authors checked whether a company is complying with the 10 principles of responsible business, as

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defined by the United Nations. These companies were excluded from the screened universes

- ESG momentum. Companies that were not included in the first step but improved ESG scores over the last three and six months are included again

Thus, 6 portfolios were constructed. Unscreened portfolio, Screened portfolios with 10 % and 25 % thresholds, each portfolio for both Global DM markets and Global All markets.

One of the finding was very high correlation among the returns of these 6 portfolios. Global All ESG screened universes actually outperformed their unscreened counterparts. For the Global DM, the 10% ESG universe outperformed, but the 25% variant underperformed slightly. However, the risks of the screened and unscreened portfolios turned out to be very close to one another. Moving from portfolio-level results to stock-level returns, it was shown that stocks in the unscreened universes are more likely to experience negative daily returns, having slightly higher downside risk than for the screened universes. The impact of ESG screening on portfolio diversification was also investigated. As anticipated, the unscreened universes consistently showed a higher diversification ratio. However, the difference was very small, and did not vary significantly over time. Hence, ESG screening, on average, did not lead to large diversification losses.

Camp "Pessimists"

As representatives of this point of view, we use Rocco Ciciretti, Ambrogio Dalo and Lammert-jan Dam paper "The Price of Taste for Socially Responsible Investment", published in June 2017 [7]. Analyzing a sample of 1000 firms from the U.S., Europe, and Asia, between 2005 and 2014, they applied Fama-Macbeth two-step cross-sectional regression procedure (Black et al., 1972, Fama and MacBeth, 1973). As factors, they used standard three Fama-French (FF) factors, momentum and their own CSR risk factor Worst Minus Best (WMB), constructed in the same way as FF.

Important data feature is that they retrieve firm level stock returns and the Market value of Equity from Datastream on a monthly basis. Regarding responsibility scores at the firm level is retrieved from VIGEO on a yearly basis.

They claim that the cost of investor taste for ESG strategies amounts to 40.6% annually in risk-adjusted returns. Moreover, the results showing this underperformance are robust against different model specifications and test assets.

Camp "Neutral"

However, there is third camp, which concludes that investors can contribute to the world without sacrificing financial performance.

We decided to investigate "Do 'Good Guys' Finish Last? The Relationship between Morningstar Sustainability Ratings and Mutual Fund Performance" paper written by Steven D. Dolvin, Jon A. Fulkerson & Anna Krukover in August 2017 [9].

While traditional financial theory suggests funds that limit their investment universe should underperform, authors found that funds with high sustainability scores have about the same risk-adjusted returns (i.e., alphas) as other funds. Thus, investors can apparently follow a

social mandate without sacrificing financial performance, particularly within the large-cap space. The second finding is connected with high Morningstar Sustainability scores, which generally mimic those of self-proclaimed SRI funds, suggesting that the new metric opens up a larger pool of potential funds for investors focused on SRI. Third aspect of the research claims that funds that specifically designate a social mandate do experience more stable cash flows, suggesting that the mandate may be more beneficial for the fund company than it is for investors.

To get these results researchers used standard practice and calculate risk-adjusted performance, using the Carhart (1997) time-series regression model, which is given as:

$$RET - RF = \alpha + \beta_1 MKT + \beta_2 SMB + \beta_3 HML + \beta_4 UMD, \tag{1}$$

where $RET - RF$ is the net portfolio return premium for the fund in each month; MKT, SMB, and HML are the factors described in Fama and French (1993); and UMD is the momentum factor from Carhart (1997). Splitting all the funds in three portfolios in terms on ESG scores (top 20%, middle 60% and bottom 20%) and estimating alpha, they, in particular, found that there is no difference in alphas between the Top 20% portfolio and the Bottom 20% portfolio.

However, it is vital to mention the features of this research: data is collected Morningstar data on all U.S. domestic mutual funds from January 2012 to December 2016, and examined funds that had ESG and sustainability scores available. The availability of the scores requires at least 50 percent of a funds holdings to be covered by Sustainalytics. Finally, there is a limitation in their sample: the Morningstar sustainability scores are only available beginning in 2016, so the sample essentially assumes that each funds sustainability score is constant prior to 2016.

In conclusion, as was shown above, the world does not have one single opinion regarding sustainable investment. There is research that analyse funds performance, other make conclusions about performance of portfolios based on "sustainable" stocks. We would like to address the problem of the scores consistency. Being provided by different sources, they can significantly deviate from one other. Secondly, we are going to analyse our own portfolios, built from stocks with sustainability scores, not funds, whose portfolios can include only 50% of scored stocks. Additionally, we would like to use longer period to include both expansions and recessions. Finally, we would like to dive deeper and investigate not only composite sustainability score (ESG), but also environmental (E), social (S), corporate governance (G) scores separately for both regions (USA and Europe) and check the robustness of results.

4. Methodology

4.1. Data Description

We used data from two data providers: Datastream and Sustainalytics.

From Datastream we downloaded the next data:

1. Returns of S&P 500 and Stoxx Europe 600 indices and weekly returns of their constituents. Weekly data from June 2003 to May 2018.
2. Filter for constituents of S&P 500 and Stoxx Europe 600 that shows for every stock whether it is a part of the index this week or not. Weekly data from June 2003 to May 2018.
3. Sustainability scores for constituents of S&P 500 and Stoxx Europe 600 indices: environmental (E), social (S), corporate governance (G), ESG and combined ESG (ESGCS) scores. Monthly data from December 2002 to December 2017.
4. Market capitalization for constituents of S&P 500 and Stoxx Europe 600 indices. Monthly data from June 2003 to May 2018.
5. Price-to-book ratio for constituents of S&P 500 and Stoxx Europe 600 indices. Monthly data from June 2003 to May 2018.
6. Firm information about constituents of S&P 500 and Stoxx Europe 600 indices, including firm name, industry and different stock identifiers.

From Sustainalytics we downloaded the next data:

1. ESG score for constituents of MSCI USA and MSCI Europe indices. Weekly data from December 2009 to December 2017.
2. Firm information about constituents of MSCI USA and MSCI Europe indices, including firm name, industry and different stock identifiers.

4.2. Methodolody for the Calculation of Sustainability Scores Provided by Datastream and Sustainalytics

Datastream contains more than 400 ESG measures publicly disclosed by companies. Sustainability scores provided by Datastream are calculated based on 178 company-level key ESG measures. They are grouped into 10 categories, illustrated on Figure 1.

A combination of the 10 categories, weighted proportionally to the number of measures within each category, delivers the three pillar scores and the final ESG score. Thus, E, S, G and ESG scores are calculated using the next formulas:

$$E = \frac{19}{61}ResourceUse + \frac{22}{61}Emissions + \frac{20}{61}Innovation \tag{2}$$

$$S = \frac{29}{63}Workforce + \frac{8}{63}HumanRights + \frac{14}{63}Community + \frac{12}{63}ProductResponsibility \tag{3}$$

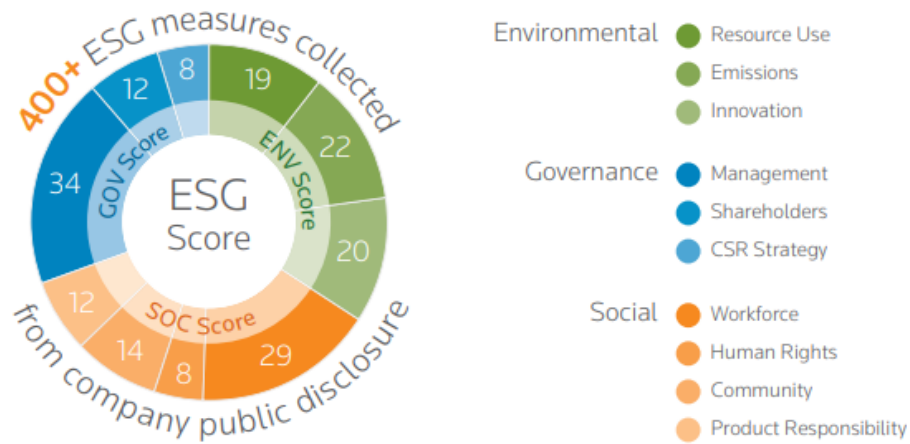$$G = \frac{34}{54}Management + \frac{12}{54}Shareholders + \frac{8}{54}CSRStrategy \tag{4}$$

Figure 1: Datastream ESG Categories (Thomson Reuters ESG Scores 2019)

$$ESG = \frac{61}{178}E + \frac{63}{178}S + \frac{54}{178}G \tag{5}$$

Additionally, ESG Controversies Score is computed based on 23 controversy measures across all 10 categories.

Finally, ESG Combined Score (ESGCS) is calculated, according to the scheme described on Figure 2 [23].

Scenario	ESG Controversies Score	ESG Score	ESG Combined Score
If Controversies Score > =50, then ESG Score = ESG Combined Score	57	38	38
If Controversies Score > ESG Score but less than 50, then ESG Combined Score = ESG Score	49	42	42
If Controversies Score < 50 and Controversies Score < ESG Score, then ESG Combined Score = average of the ESG & Controversies Score	48	49	48.5

Figure 2: Final ESG Combined Score Assembly (Thomson Reuters ESG Scores 2019)

ESG score, provided by Sustainalytics, measures how well companies solve the environmental, social and governance problems that can negatively affect their business and stakeholders.

The following indicators are assessed for the environmental, social and governance scores:

- Preparedness measures. How well company manages ESG risks through programs, policies and management systems?

- Disclosure indicators. Does company report according to best practice and notify about relevant ESG issues?
- Quantitative (e.g., amount of pollutant emission) and Qualitative (e.g., involvement in ESG controversies) performance measures [22].

4.3. Capstone Project Methodology

The first step of our project is data download. We need to download from Datastream and Sustainalytics all required data, described in Section 4.1.

The second step is data preparation. We need to determine how many companies from index have E, S, G, ESG and ESGCS Datastream scores. The amount must be sufficient. Additionally, we introduce a new ESG Equal score that is equally-weighted average of E,S and G scores.

$$ESG_{Equal} = \frac{1}{3}E + \frac{1}{3}S + \frac{1}{3}G \tag{6}$$

The third step answers the first core question: "How consistent are scores provided by different suppliers?" Consistency of the scores is analyzed by checking correlation between Sustainalytics ESG score and Datastream E, S, G, ESG, ESGCS and ESG Equal scores (6 sustainability scores in total).

The fourth step deals with ESG-scores-based portfolios creation. The next substeps are required for each of 6 scores:

1. Split all companies into five clusters based on the sustainability score values in the way that portfolio 1 contains 20% of all companies with the lowest score, . . . , portfolio 5 contains 20% with the highest one.
2. Create five equally-weighted portfolios.
3. Reshuffle the portfolios in June of every year based on the sustainability score values from December of previous year. It is enough to reshuffle the portfolios once per year because Datastream sustainability scores are updated on annual basis.

Additionally, the all-best portfolio need to be constructed. It contains stocks from top 20% of each E, S and G scores.

The fifth step is performance analysis. Several indicators are important to reflect:

1. Average annual return
2. Annual standard deviation
3. Sharpe ratio
4. Cumulative return

These characteristics are compared with those of the benchmark index and all-best portfolio. This step will provide answer to the second core question: "Is it true that"bad" companies could give better performance and investing in "good" stocks could lead to underperformance?"

In the sixth step we analyze size, value and momentum characteristics of the portfolios. Size score is represented by market capitalization, price-to-book ratio is used as a value score and momentum score is a six-month cumulative return. Then we need to apply normalization to these scores, that scales them in the range [0,1]. The next formula is used for normalization:

$$NormalizedScore = \frac{Score - ScoreMin}{ScoreMax - ScoreMin} \tag{7}$$

Our claim is that ESG scores are positively correlated with company market capitalization (size effect).

In the seventh step we analyze sensitivity to the market movements, calculating Market Beta, Bull and Bear Market Betas. Bull/Bear Market Beta measures sensitivity of a return of the stock to positive/negative return of the benchmark.

Additionally, we conduct the analysis above for double-sorted portfolios. Thus, we can capture the size effect. Firstly, we divide all stocks into two equal halves, based on the size score. Secondly, we divide each half into five parts based on the sustainability score. After that, we correspondingly merge stocks from both halves, forming five double-sorted portfolios in the result.

Finally, we examine robustness of our analysis, switching from S&P500 universe to Stoxx Europe 600 universe. The third core question of our research is supposed to be answered in this section. Having all the performance indicators and other results for USA market, we will check if the picture is the same for Europe.

Regarding implementation, we use R language, which provides a powerful set of functions for data analysis and incredible visualization packages. Moreover, the final document is done using R knitr library, which helps to easily incorporate R results in .pdf document.

5. Results

5.1. S&P 500 Universe

The Figure 3 shows the number of companies in the S&P 500 index with existing sustainability scores. For all scores and all time points this value lays in the range [377;505] that is sufficient for the analysis. For every time point the number of companies with E, S and G scores is the same. The number of companies with ESG and ESGCS scores differs for 52 weeks.
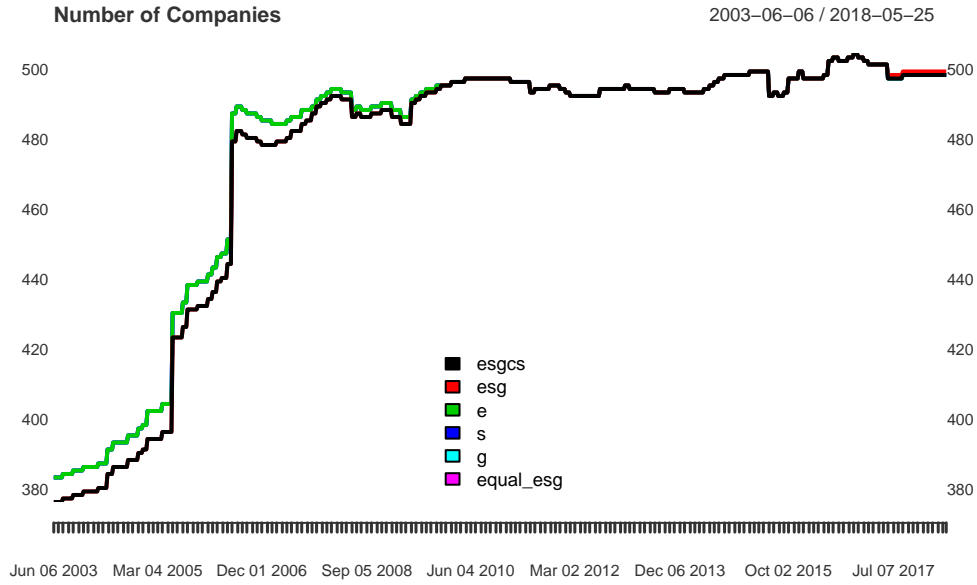
Figure 3: Number of Companies with Datastream Sustainability Scores

In the Figure 4 correlation between Sustainalytics ESG score and Datastream sustainability scores is illustrated. In all cases correlation is positive. The highest correlation of about 0.7 is observed for Equal ESG score, while ESGCS has the lowest correlation with the Sustainalytics ESG score (smaller than 0.4)
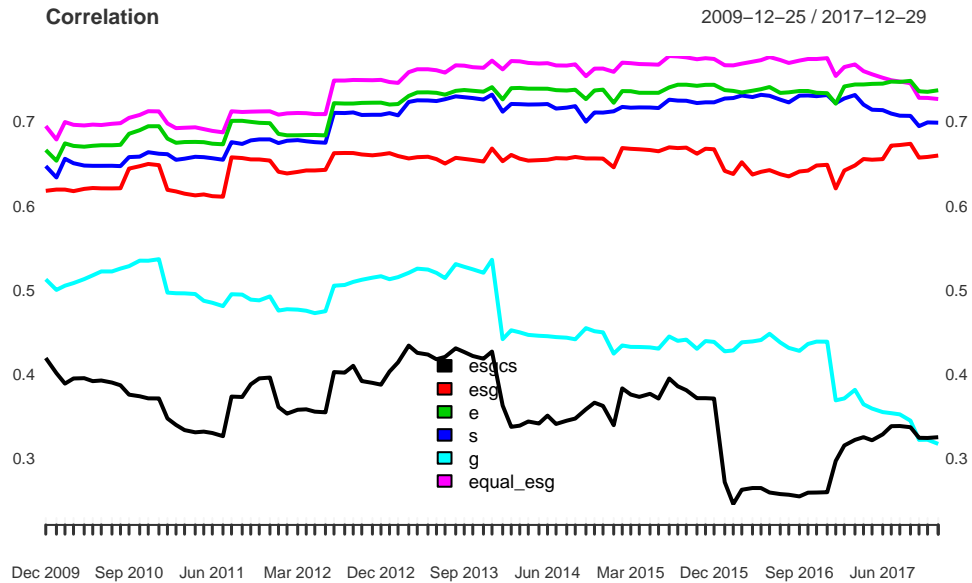
Figure 4: Correlation between Sustainalytics ESG Score and Datastream Sustainability Scores

5.1.1. Portfolios without Size Sorting

Figures 5 - 10 represent the cumulative returns for portfolios based on all six scores: ESGCS, E, S, G, ESG and Equal ESG. All 30 portfolios outperform the benchmark - S&P 500 index. For all scores, except of the S score, Portfolio 5, consisting of "good" companies in terms of sustainability, is one of the best performing portfolios.
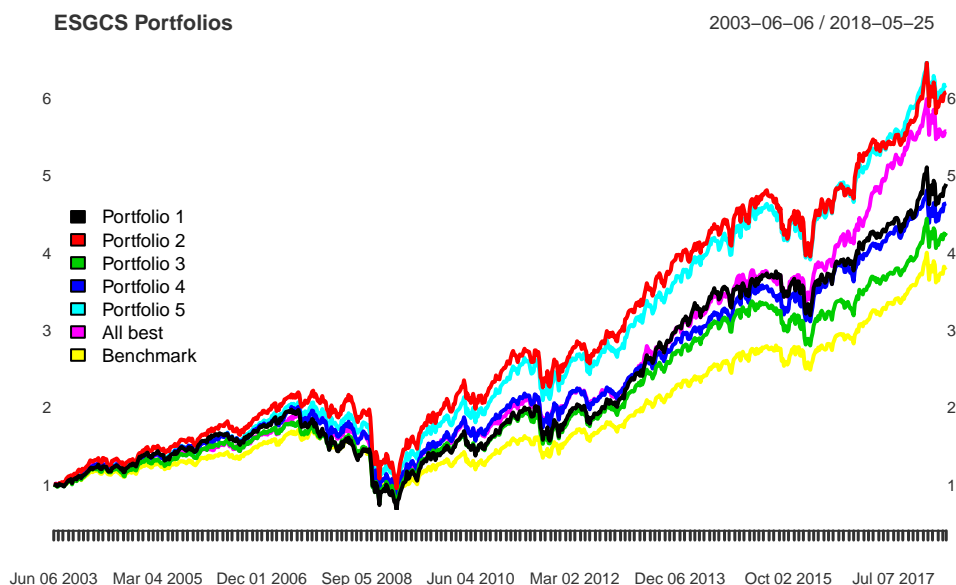
Figure 5: Cumulative Returns of ESGCS Portfolios
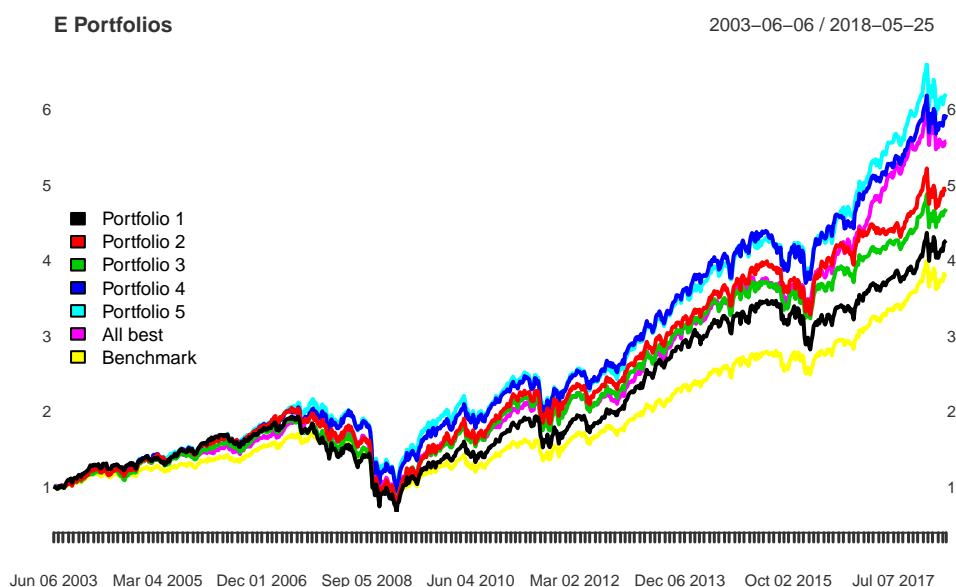
Figure 6: Cumulative Returns of E Portfolios
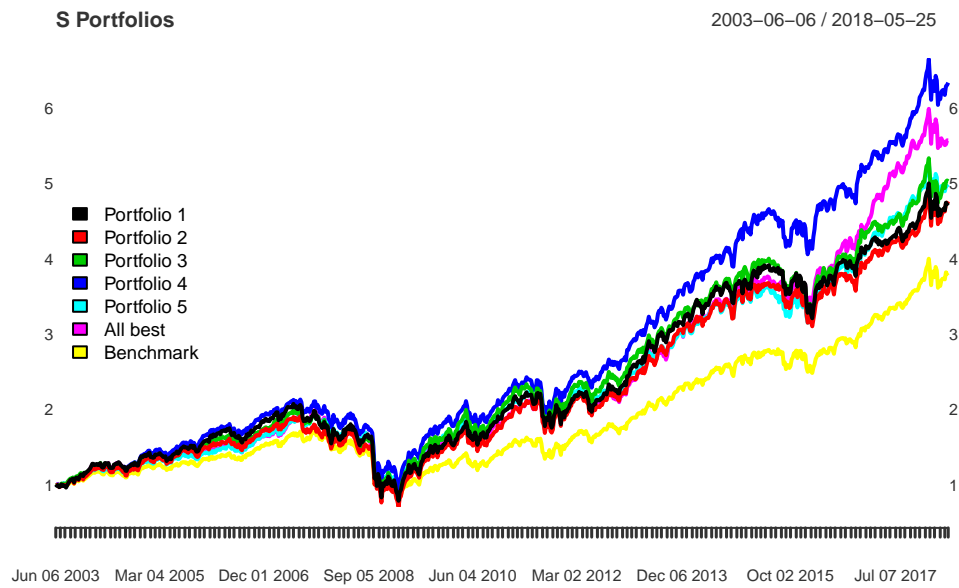
Figure 7: Cumulative Returns of S Portfolios
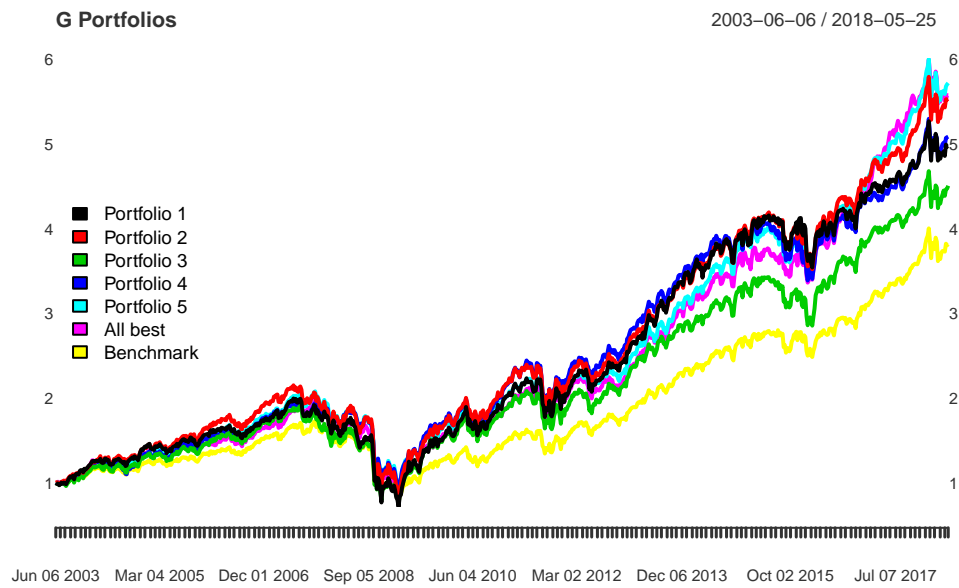
Figure 8: Cumulative Returns of G Portfolios
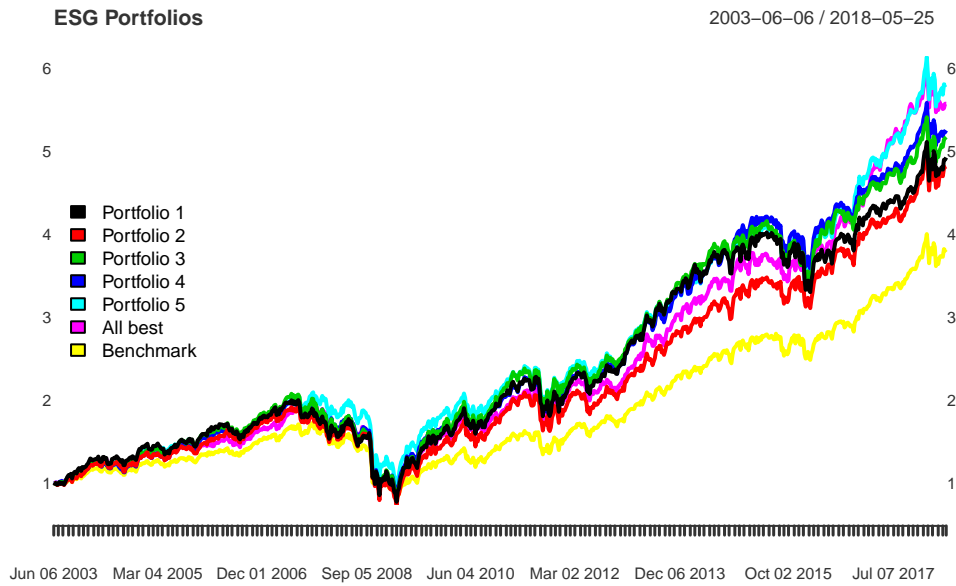
Figure 9: Cumulative Returns of ESG Portfolios
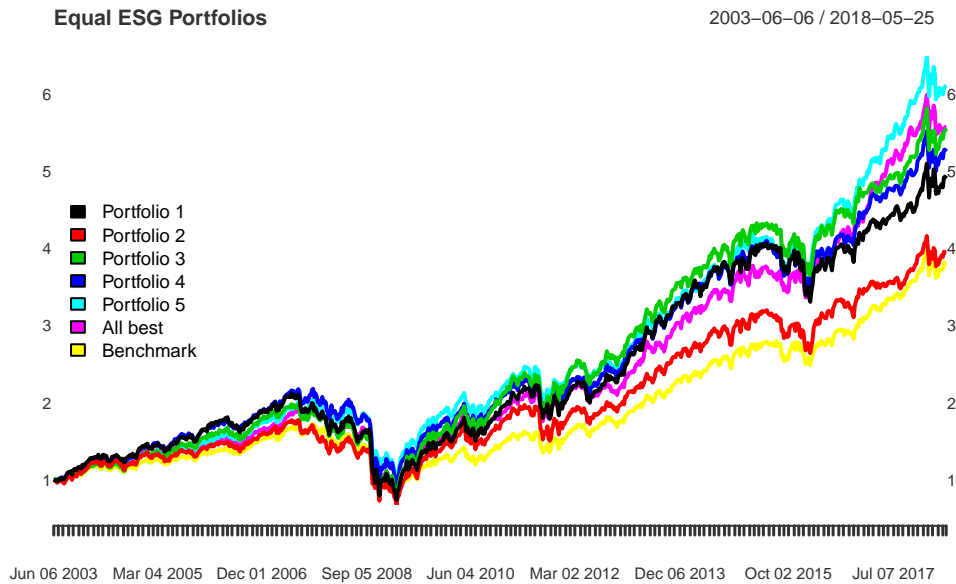
Figure 10: Cumulative Returns of Equal ESG Portfolios

Tables 1-3 show average annual return, annual standard deviation and Sharpe ratio for constructed portfolios. Based on average annual return, portfolio 5 outperforms portfolio 1 for all scores, except of the S score. The remarkable fact is that portfolio 5 has the lowest risk and portfolio 1 has the highest risk (except of E score), measured with standard deviation. Based on the Sharpe ratio, portfolio 5 is a winner for all scores, except of the S score.

Table 1: Average Annual Return

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	12.84	12.82	11.92	12.59	12.94	12.95
Portfolio 2	13.99	12.63	12.92	12.53	13.52	11.36
Portfolio 3	11.55	12.91	12.21	12.96	12	13.46
Portfolio 4	12	12.78	13.53	13.95	12.61	12.86
Portfolio 5	13.84	13.29	13.72	12.21	13.13	13.47

Table 2: Annual Standard Deviation

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	21.12	20.86	21.12	20.87	21.12	21.31
Portfolio 2	19.68	20.64	21.17	20.5	20.49	20.91
Portfolio 3	19.32	19.7	19.48	20.81	19.7	20.06
Portfolio 4	18.64	18.39	18.1	18	18.69	18.54
Portfolio 5	18.38	17.59	17.73	17.15	17.25	16.64

Table 3: Sharpe Ratio

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.56	0.57	0.52	0.56	0.57	0.56
Portfolio 2	0.66	0.56	0.56	0.56	0.61	0.5
Portfolio 3	0.55	0.6	0.58	0.57	0.56	0.62
Portfolio 4	0.59	0.64	0.69	0.72	0.62	0.64
Portfolio 5	0.7	0.7	0.72	0.65	0.7	0.75

The table 4 contains statistics for the benchmark S&P 500 index and the all-best portfolio. The benchmark has the lowest both average annual return and annual standard deviation compared to all portfolios.

Table 4: Benchmark and All-Best Portfolio Statistics

	benchmark	all_best_portfolio
Average Annual Return	10.31	13.04
Annual Standard Deviation	16.34	17.78
Sharpe Ratio	0.57	0.68

Tables 6-9 illustrate average sustainability, size, value and momentum scores for constructed portfolios. We can see that portfolios differ significantly based on the average sustainability score, while they have almost the same average value and momentum scores. Regarding the average size score, it increases monotonically from portfolio 1 to portfolio 5, except of the

ESGCS score.

Table 6: Average Sustainability Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	26.97	33.77	14.32	18.17	54.01	33.24
Portfolio 2	35.8	47.54	30.74	38.86	72.97	49.06
Portfolio 3	42.47	56.64	53.28	57.15	81.29	63.28
Portfolio 4	51.16	65.75	74.17	76.06	87.11	76.47
Portfolio 5	66.83	78.12	91.56	91.28	93.26	89.37

Table 7: Average Size Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.0491	0.0273	0.0312	0.0293	0.0403	0.029
Portfolio 2	0.0787	0.0306	0.0377	0.0382	0.0493	0.0321
Portfolio 3	0.0739	0.044	0.0403	0.0489	0.054	0.0491
Portfolio 4	0.0501	0.0684	0.0665	0.0734	0.0656	0.0719
Portfolio 5	0.0493	0.1271	0.1227	0.1099	0.0904	0.1164

Table 8: Average Value Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.5875	0.5863	0.5866	0.5872	0.5875	0.5866
Portfolio 2	0.5871	0.5891	0.5878	0.5884	0.589	0.5887
Portfolio 3	0.588	0.5882	0.589	0.5876	0.5873	0.588
Portfolio 4	0.5887	0.5877	0.5881	0.5887	0.5878	0.5886
Portfolio 5	0.5872	0.5871	0.5869	0.5867	0.5868	0.5867

Table 9: Average Momentum Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.3843	0.3842	0.384	0.3845	0.3842	0.3845
Portfolio 2	0.3849	0.3846	0.3844	0.3844	0.3848	0.3833
Portfolio 3	0.3844	0.3844	0.3841	0.384	0.384	0.3848
Portfolio 4	0.3846	0.3852	0.3854	0.3862	0.3848	0.385
Portfolio 5	0.3855	0.3855	0.3859	0.3848	0.386	0.3861

Tables 10-12 contain Market, Bull and Bear Market Betas for constructed portfolios. We observe that they all decrease from portfolio 1 to portfolio 5.

Table 10: Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	1.24	1.22	1.23	1.22	1.24	1.24
Portfolio 2	1.17	1.21	1.24	1.21	1.21	1.23
Portfolio 3	1.15	1.17	1.15	1.23	1.17	1.19
Portfolio 4	1.11	1.1	1.08	1.08	1.11	1.11
Portfolio 5	1.1	1.06	1.06	1.03	1.03	1

Table 11: Bull Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	1.35	1.34	1.35	1.31	1.36	1.35
Portfolio 2	1.23	1.32	1.35	1.33	1.31	1.36
Portfolio 3	1.24	1.23	1.23	1.31	1.25	1.26
Portfolio 4	1.16	1.13	1.09	1.1	1.17	1.12
Portfolio 5	1.13	1.09	1.1	1.08	1.05	1.02

Table 12: Bear Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	1.23	1.18	1.2	1.22	1.22	1.24
Portfolio 2	1.13	1.21	1.25	1.19	1.21	1.2
Portfolio 3	1.14	1.13	1.14	1.2	1.12	1.16
Portfolio 4	1.08	1.09	1.06	1.05	1.1	1.11
Portfolio 5	1.09	1.06	1.02	1.02	1.02	0.97

5.1.2. Double-Sorted Portfolios

Figures 11 - 16 represent the cumulative returns for portfolios based on all six scores after size sorting. All 30 portfolios outperform the benchmark - S&P 500 index. For all scores the all-best portfolio shows the best performance.
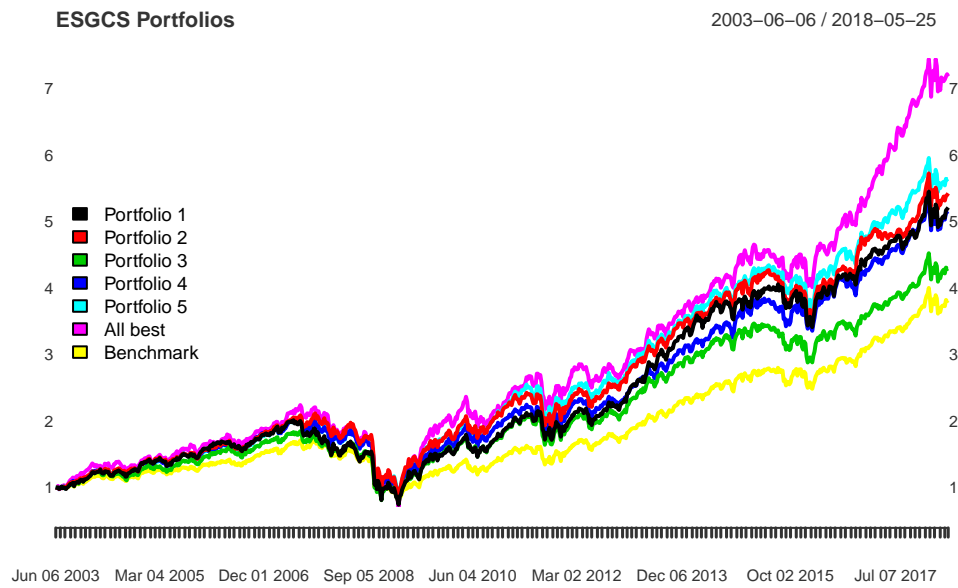
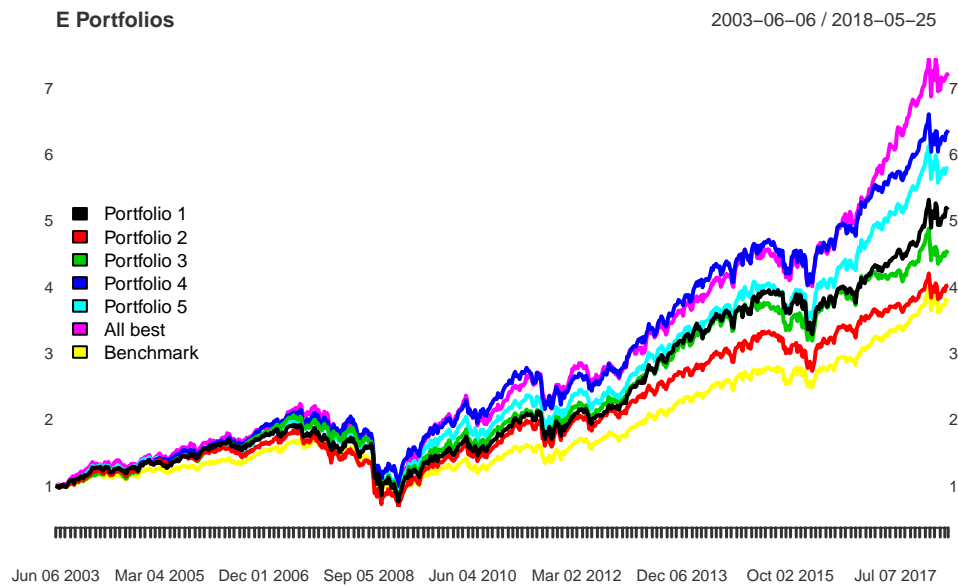Figure 11: Cumulative Returns of ESGCS Portfolios

Figure 12: Cumulative Returns of E Portfolios
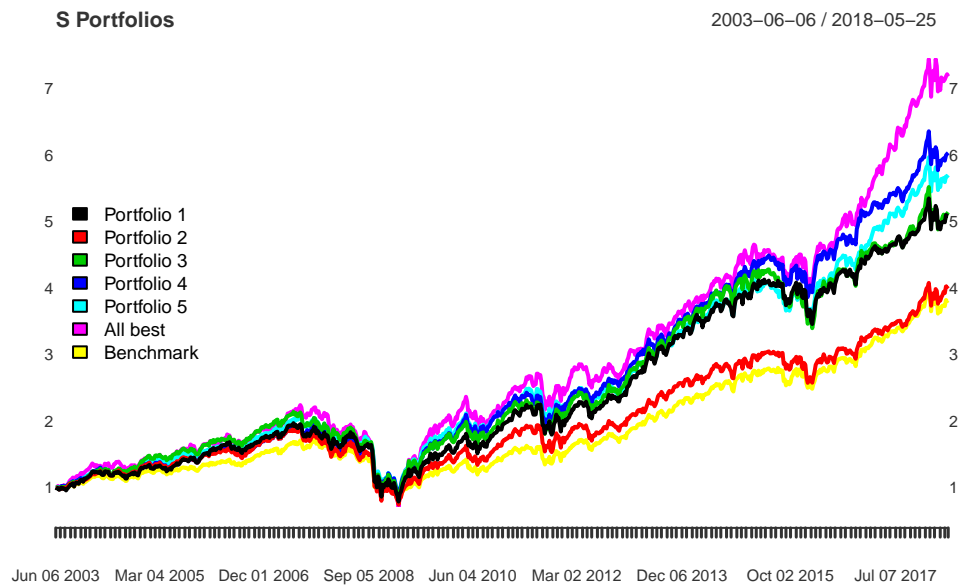
Figure 13: Cumulative Returns of S Portfolios
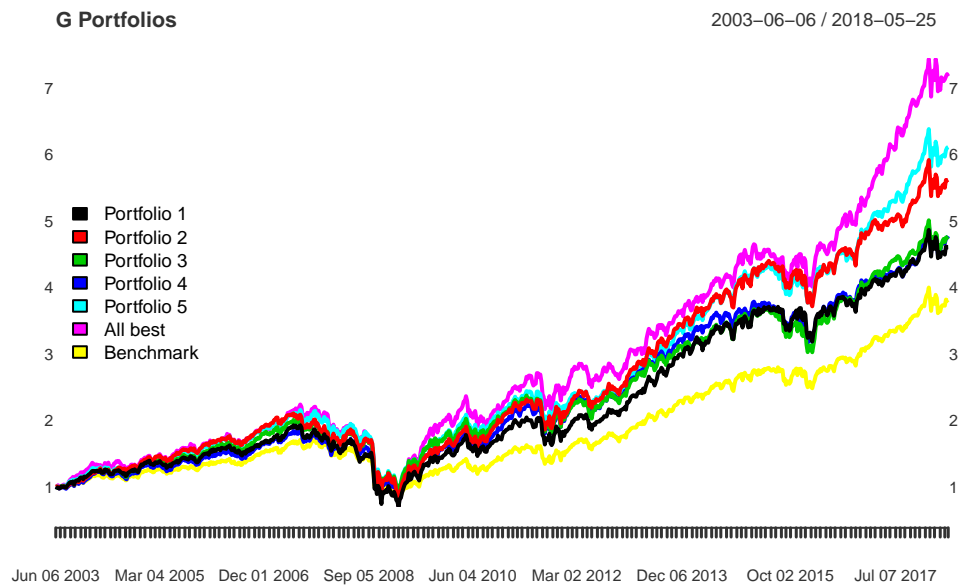
Figure 14: Cumulative Returns of G Portfolios
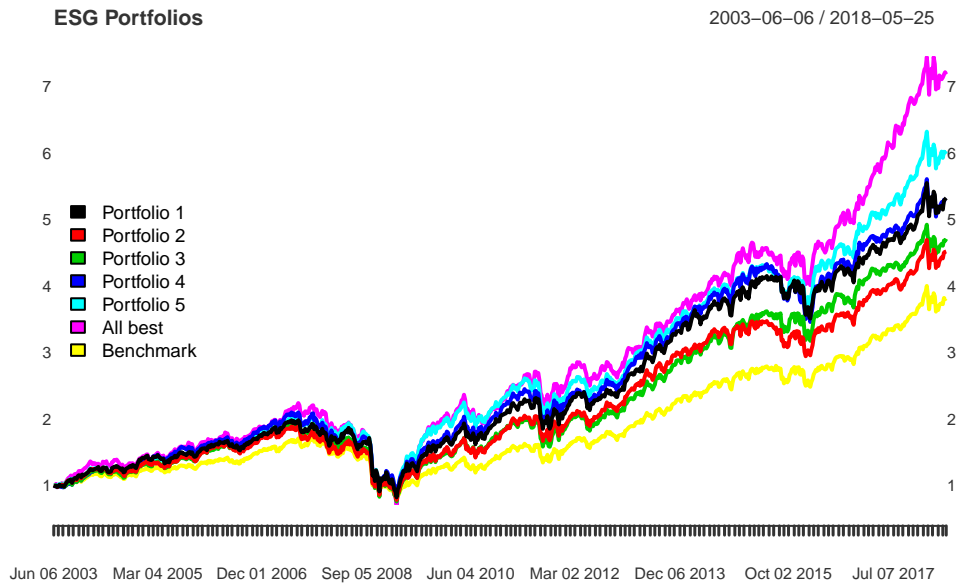
Figure 15: Cumulative Returns of ESG Portfolios
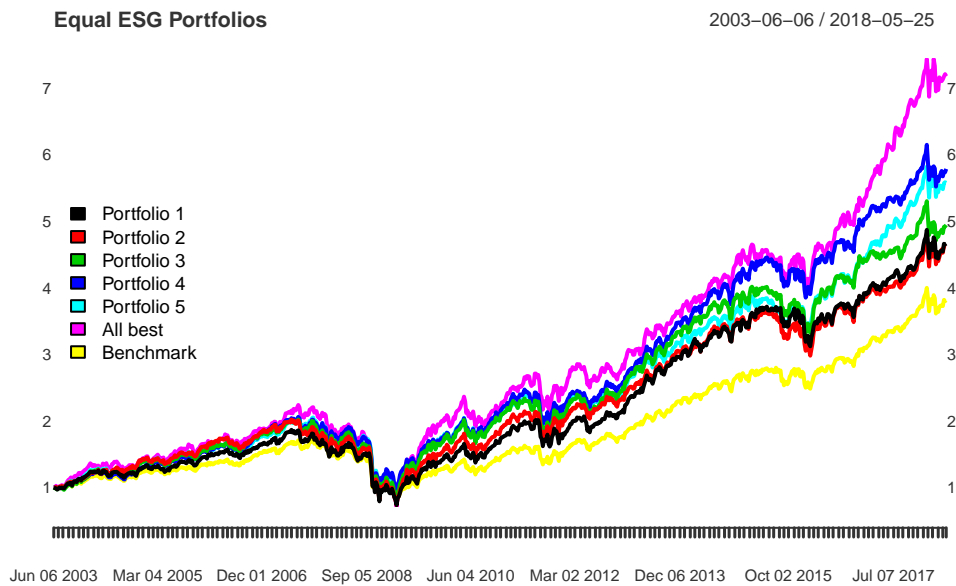
Figure 16: Cumulative Returns of Equal ESG Portfolios

Tables 13-15 show average annual return, annual standard deviation and Sharpe ratio for double-sorted portfolios. Based on average annual return, portfolio 5 outperforms portfolio 1 for all scores. The interesting fact is that portfolio 5 has the lowest risk (except of E and ESG scores) and portfolio 1 has the highest risk (except of Equal ESG score), measured with standard deviation. Based on the Sharpe ratio, portfolio 5 is a winner for all scores, except of E and ESG scores.

Table 13: Average Annual Return

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	13.12	13.18	13.1	12.94	12.39	12.31
Portfolio 2	13.33	11.88	11.33	11.22	13.51	12.33
Portfolio 3	11.56	12.31	12.09	13	12.32	12.75
Portfolio 4	12.74	12.94	14.06	13.83	12.18	13.41
Portfolio 5	13.26	13.84	13.53	13.27	13.8	13.13

Table 14: Annual Standard Deviation

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	20.43	20.04	20.38	20.36	20.88	20.07
Portfolio 2	20.2	18.95	20	19.44	19.9	20.46
Portfolio 3	19.01	19.76	19.76	20.25	19.42	20.31
Portfolio 4	18.93	19.02	18.46	19.15	18.6	18.36
Portfolio 5	18.43	19.14	18.98	18.18	18.46	18.17

Table 15: Sharpe Ratio

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.59	0.61	0.59	0.59	0.55	0.56
Portfolio 2	0.61	0.57	0.52	0.53	0.63	0.55
Portfolio 3	0.56	0.57	0.56	0.59	0.58	0.58
Portfolio 4	0.62	0.63	0.71	0.67	0.6	0.68
Portfolio 5	0.67	0.67	0.66	0.67	0.69	0.67

The table 16 contains statistics for the benchmark S&P 500 index and the double-sorted all-best portfolio. The all-best portfolio has the highest both average annual return and annual standard deviation.

Table 16: Benchmark and All-Best Portfolio Statistics

	benchmark	all_best_portfolio
Average Annual Return	10.31	15.36
Annual Standard Deviation	16.34	21.08
Sharpe Ratio	0.57	0.68

Tables 17-20 illustrate average sustainability, size, value and momentum scores for double-sorted portfolios. We can see that portfolios differ significantly based on the average sustainability score, while they have almost the same average value and momentum scores. Regarding the average size score, it increases monotonically from portfolio 1 to portfolio 5,

except of the ESGCS score.

Table 17: Average Sustainability Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	27.07	35.22	15.63	20.46	54.26	34.56
Portfolio 2	35.71	48.68	33.3	41.28	73.01	50.77
Portfolio 3	42.5	57.03	54.19	58.55	81.13	63.67
Portfolio 4	50.95	64.79	71.96	72.95	86.95	75.15
Portfolio 5	66.01	75.4	87.73	87.1	92.74	86.34

Table 18: Average Size Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.0563	0.0386	0.0404	0.0428	0.0475	0.0383
Portfolio 2	0.0734	0.0417	0.0427	0.0465	0.0552	0.0454
Portfolio 3	0.0717	0.0545	0.0494	0.0594	0.0564	0.0607
Portfolio 4	0.0549	0.0689	0.0701	0.0688	0.0628	0.0682
Portfolio 5	0.0453	0.0941	0.0957	0.0822	0.0771	0.086

Table 19: Average Value Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.5877	0.5871	0.5867	0.5874	0.5877	0.5874
Portfolio 2	0.5871	0.5883	0.5881	0.5878	0.589	0.5877
Portfolio 3	0.5877	0.5886	0.5887	0.5888	0.5875	0.5884
Portfolio 4	0.5886	0.5877	0.5881	0.5876	0.5877	0.5885
Portfolio 5	0.5876	0.587	0.587	0.5868	0.5866	0.5866

Table 20: Average Momentum Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.385	0.3859	0.3863	0.3863	0.3845	0.3858
Portfolio 2	0.3843	0.3849	0.3838	0.3843	0.3851	0.3845
Portfolio 3	0.3843	0.3848	0.384	0.3839	0.3843	0.3837
Portfolio 4	0.3849	0.3844	0.3852	0.385	0.3842	0.3851
Portfolio 5	0.3852	0.3838	0.3844	0.3842	0.3856	0.3846

Tables 21-23 contain Market, Bull and Bear Market Betas for double-sorted portfolios. We observe that all Betas of portfolio 1 - portfolio 3 are higher than those for portfolio 4 - portfolio 5.

Table 21: Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	1.21	1.18	1.2	1.2	1.23	1.19
Portfolio 2	1.19	1.13	1.18	1.15	1.18	1.21
Portfolio 3	1.13	1.17	1.17	1.2	1.15	1.2
Portfolio 4	1.13	1.13	1.1	1.13	1.11	1.09
Portfolio 5	1.1	1.13	1.12	1.08	1.1	1.08

Table 22: Bull Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	1.29	1.27	1.29	1.28	1.33	1.27
Portfolio 2	1.29	1.19	1.25	1.26	1.27	1.33
Portfolio 3	1.2	1.26	1.26	1.25	1.24	1.28
Portfolio 4	1.19	1.18	1.15	1.21	1.16	1.13
Portfolio 5	1.13	1.19	1.17	1.13	1.13	1.12

Table 23: Bear Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	1.19	1.16	1.17	1.2	1.21	1.18
Portfolio 2	1.16	1.09	1.18	1.13	1.18	1.18
Portfolio 3	1.13	1.16	1.16	1.19	1.12	1.19
Portfolio 4	1.1	1.11	1.07	1.09	1.08	1.06
Portfolio 5	1.08	1.13	1.08	1.06	1.09	1.06

5.2. Stoxx Europe 600 Universe

Figure 17 shows the number of companies in the Stoxx Europe 600 index with existing sustainability scores. For all scores and all time points this value lays in the range [345;599] that is sufficient for the analysis. For every time point the number of companies with ESG and ESGCS scores is the same. The number of companies with E score matches that for S scores, while for G score this indicator differs from them for 4 weeks.
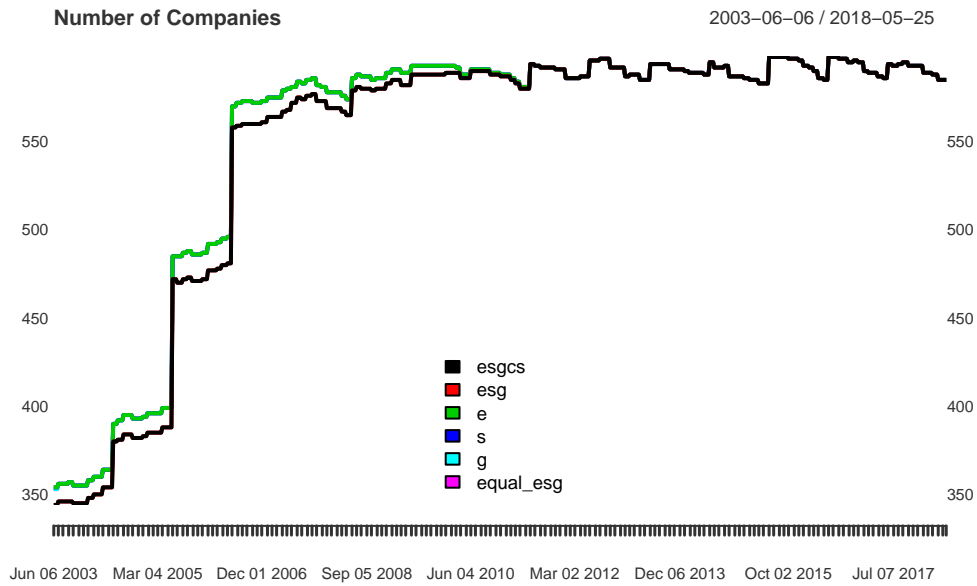
Figure 17: Number of Companies with Datastream Sustainability Scores

In the Figure 18 correlation between Sustainalytics ESG score and Datastream sustainability scores is illustrated. In all cases correlation is positive. The highest correlation of about 0.6 is observed for S score, while ESGCS and G scores have the lowest correlation with the Sustainalytics ESG score (smaller than 0.4)
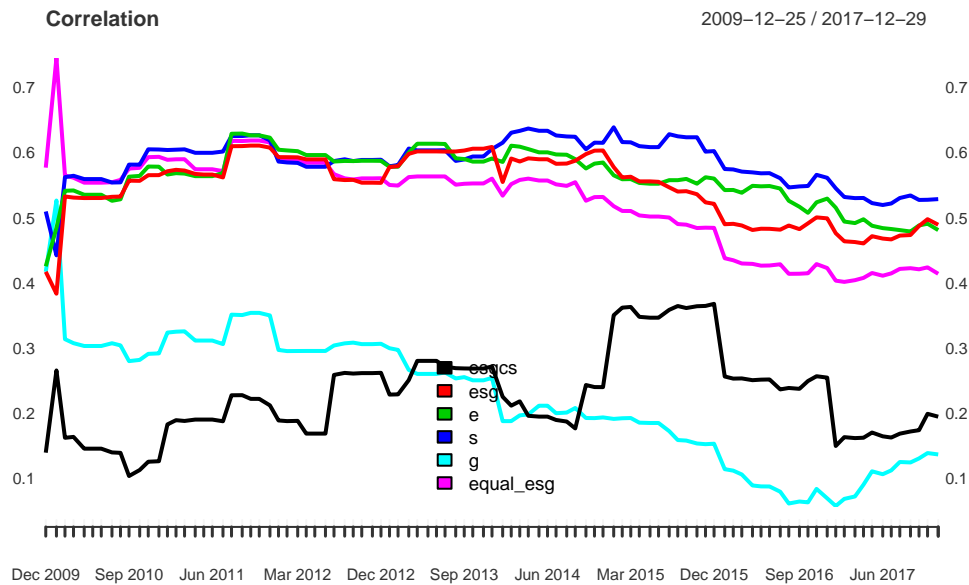

Figure 18: Correlation between Sustainalytics ESG Score and Datastream Sustainability Scores

5.2.1. Portfolios without Size Sorting

Figures 19 - 24 represent the cumulative returns for portfolios based on all six scores: ESGCS, E, S, G, ESG and Equal ESG. All 30 portfolios outperform the benchmark - Stoxx Europe 600 index. For all scores, except of the ESGCS score, Portfolio 2 performs best. The worst performing for all scores is the all-best portfolio.
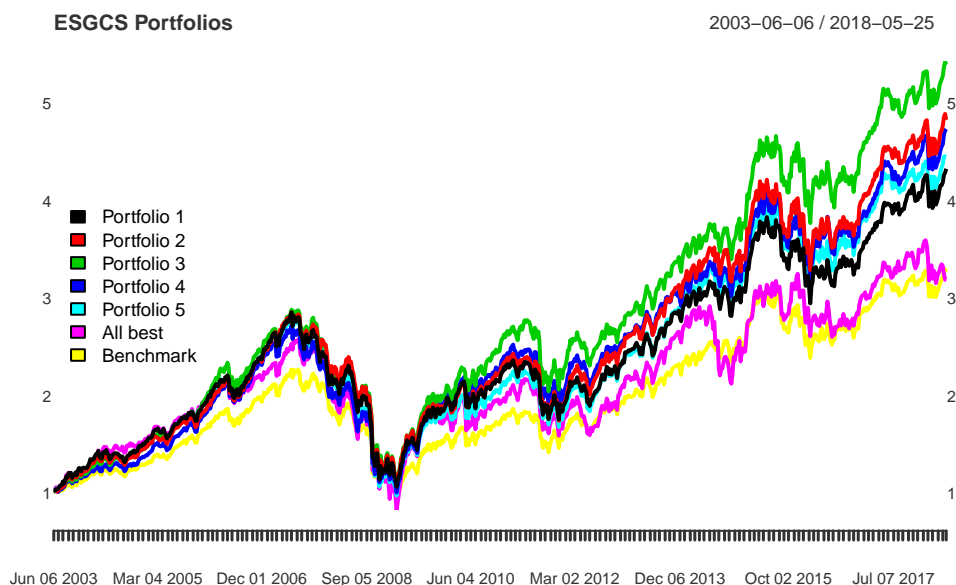

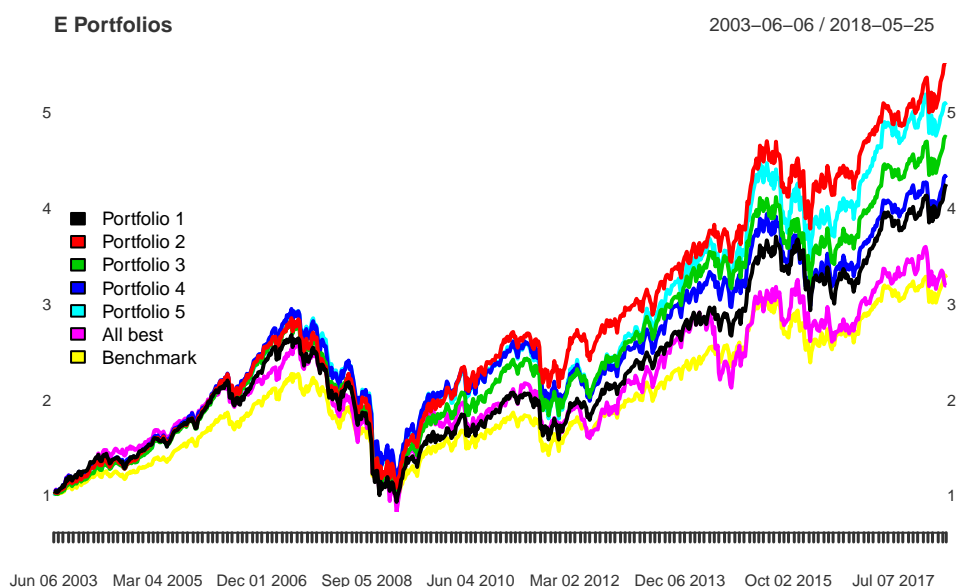Figure 19: Cumulative Returns of ESGCS Portfolios

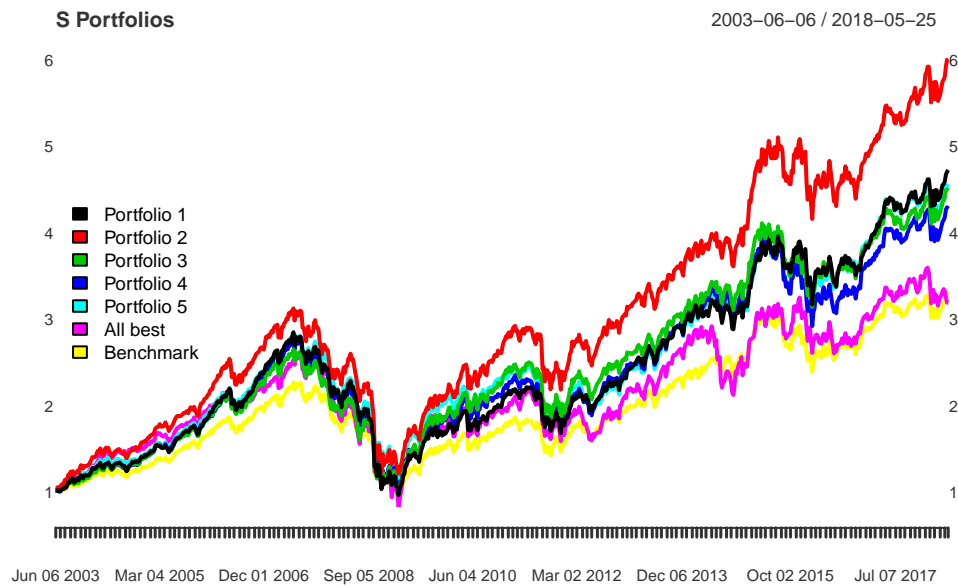Figure 20: Cumulative Returns of E Portfolios

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Figure 21: Cumulative Returns of S Portfolios
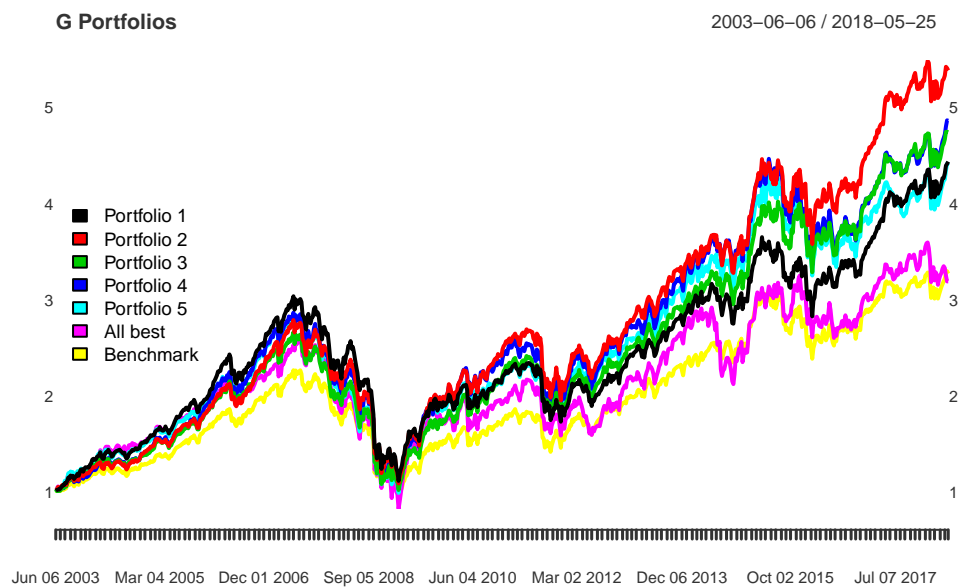
Figure 22: Cumulative Returns of G Portfolios
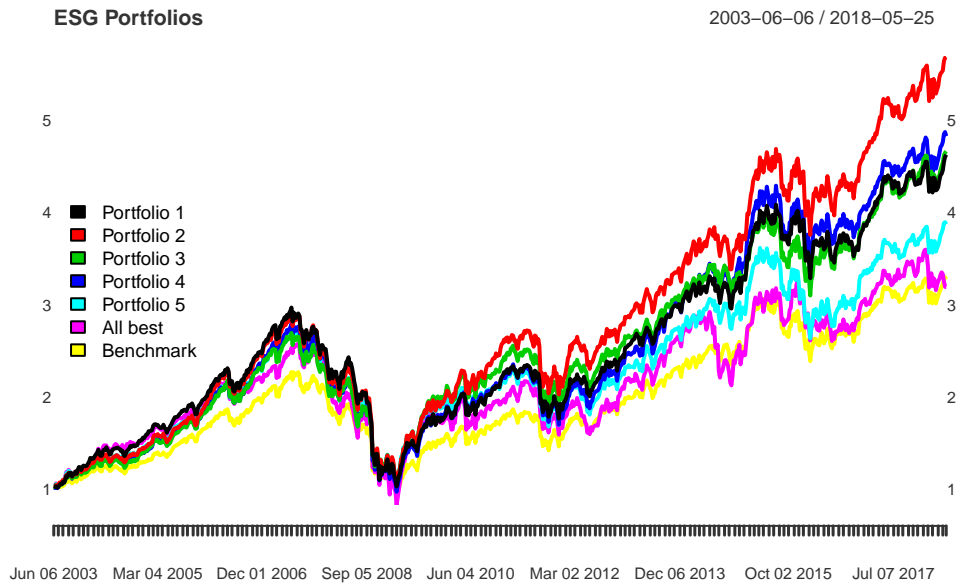
Figure 23: Cumulative Returns of ESG Portfolios
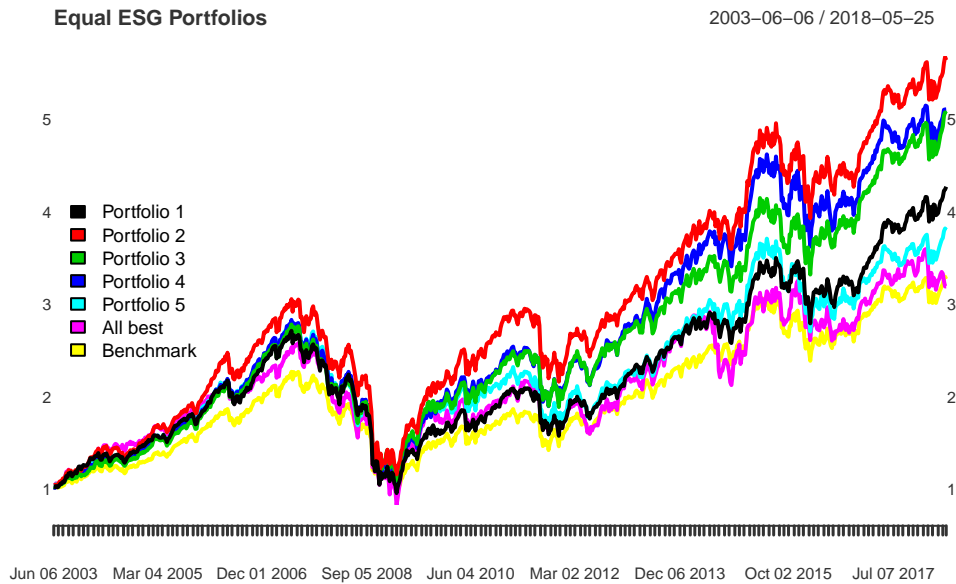
Figure 24: Cumulative Returns of Equal ESG Portfolios

Tables 24-26 show average annual return, annual standard deviation and Sharpe ratio for constructed portfolios. Based on average annual return, no patterns are defined. The surprising fact is that now portfolio 5 has the highest risk (except of ESGCS and S scores) and portfolio 1 has the lowest risk, measured with standard deviation. Portfolio 1 has greater or equal Sharpe ratio than portfolio 5, except of the E score.

Table 24: Average Annual Return

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	11.57	11.95	11.46	12.16	11.61	11.42
Portfolio 2	12.44	13.45	13.18	13.83	13	13.41
Portfolio 3	13.08	12.11	12.17	12.03	12.2	12.64
Portfolio 4	12.29	12.45	11.65	11.62	12.7	12.82
Portfolio 5	11.89	11.08	13.03	11.96	12.02	11.03

Table 25: Annual Standard Deviation

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	18.73	18.44	18.76	18.78	18.08	18.4
Portfolio 2	19.48	19.15	18.89	19.2	18.67	19.19
Portfolio 3	19	19.04	18.76	19.89	18.93	18.97
Portfolio 4	19.39	19.57	19.26	19.42	20.55	19.54
Portfolio 5	19.41	20.04	20.74	19.19	20.53	20.31

Table 26: Sharpe Ratio

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.56	0.59	0.56	0.59	0.59	0.57
Portfolio 2	0.59	0.65	0.64	0.67	0.64	0.65
Portfolio 3	0.64	0.58	0.6	0.55	0.59	0.61
Portfolio 4	0.58	0.59	0.55	0.55	0.57	0.6
Portfolio 5	0.56	0.5	0.58	0.57	0.54	0.49

Table 27 contains statistics for the benchmark Stoxx Europe 600 index and the all-best portfolio. The benchmark has the lowest both average annual return and annual standard deviation compared to all portfolios. Excluding from consideration the benchmark, the all-best portfolio has the worst characteristics.

Table 27: Benchmark and All-Best Portfolio Statistics

	benchmark	all_best_portfolio
Average Annual Return	9.56	10.61
Annual Standard Deviation	17.88	23.58
Sharpe Ratio	0.48	0.41

Tables 28-31 illustrate average sustainability, size, value and momentum scores for constructed portfolios. We can see that portfolios differ significantly based on the average sustainability score, while they have almost the same average value and momentum scores. Regarding the

average size score, it increases monotonically from portfolio 1 to portfolio 5, except of ESGCS and G score.

Table 28: Average Sustainability Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	31.57	36.93	24.52	27.24	18.32	30.35
Portfolio 2	41.8	51.95	57.16	61.16	42.79	57.03
Portfolio 3	50.25	61.06	79.51	79.67	61.62	71.35
Portfolio 4	60.86	69.19	89.97	89.88	75.35	80.8
Portfolio 5	73.39	79.57	94.37	95.68	88.17	88.97

Table 29: Average Size Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.0211	0.0118	0.0116	0.0118	0.0192	0.0143
Portfolio 2	0.0344	0.0153	0.0147	0.015	0.0265	0.0158
Portfolio 3	0.0222	0.021	0.0225	0.0249	0.0271	0.0257
Portfolio 4	0.0196	0.0298	0.0343	0.0347	0.0261	0.0309
Portfolio 5	0.0262	0.0453	0.0397	0.0362	0.0241	0.036

Table 30: Average Value Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.3772	0.3781	0.379	0.3785	0.3768	0.3788
Portfolio 2	0.377	0.3784	0.3775	0.3783	0.3772	0.3775
Portfolio 3	0.3782	0.3769	0.3773	0.376	0.3783	0.3767
Portfolio 4	0.3773	0.3766	0.3762	0.377	0.3768	0.3769
Portfolio 5	0.3768	0.3765	0.3764	0.3766	0.3772	0.3765

Table 31: Average Momentum Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.4136	0.4139	0.4134	0.4142	0.4136	0.4135
Portfolio 2	0.4139	0.4151	0.4147	0.4153	0.4147	0.415
Portfolio 3	0.4147	0.4135	0.4144	0.4134	0.4143	0.4144
Portfolio 4	0.4139	0.4143	0.4136	0.4136	0.4143	0.4143
Portfolio 5	0.4138	0.4129	0.4141	0.4137	0.4132	0.4128

Tables 32-34 contain Market, Bull and Bear Market Betas for constructed portfolios. We observe that portfolio 5 has all betas higher than portfolio 1.

Table 32: Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	1.01	0.98	1	1	0.96	0.98
Portfolio 2	1.06	1.03	1.01	1.03	1.01	1.03
Portfolio 3	1.03	1.03	1.02	1.07	1.03	1.03
Portfolio 4	1.05	1.07	1.05	1.06	1.11	1.07
Portfolio 5	1.06	1.1	1.13	1.05	1.1	1.11

Table 33: Bull Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.98	0.95	0.97	0.97	0.9	0.93
Portfolio 2	1.08	1.02	1.03	1.03	0.99	1.01
Portfolio 3	1.05	1.05	1.01	1.11	1.02	1.04
Portfolio 4	1.06	1.07	1.06	1.06	1.16	1.09
Portfolio 5	1.06	1.13	1.17	1.06	1.17	1.15

Table 34: Bear Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	1	1.03	1.04	1.06	1	1.03
Portfolio 2	1.08	1.05	1.01	1.03	1.04	1.05
Portfolio 3	1.04	1.01	1.03	1.08	1.02	1.01
Portfolio 4	1.07	1.09	1.05	1.05	1.11	1.06
Portfolio 5	1.07	1.08	1.14	1.05	1.09	1.11

5.2.2. Double-Sorted Portfolios

Figures 25 - 30 represent the cumulative returns for portfolios based on all six scores after size sorting. All 30 portfolios outperform the benchmark - Stoxx Europe 600 index. For all scores the all-best portfolio shows the worst performance.
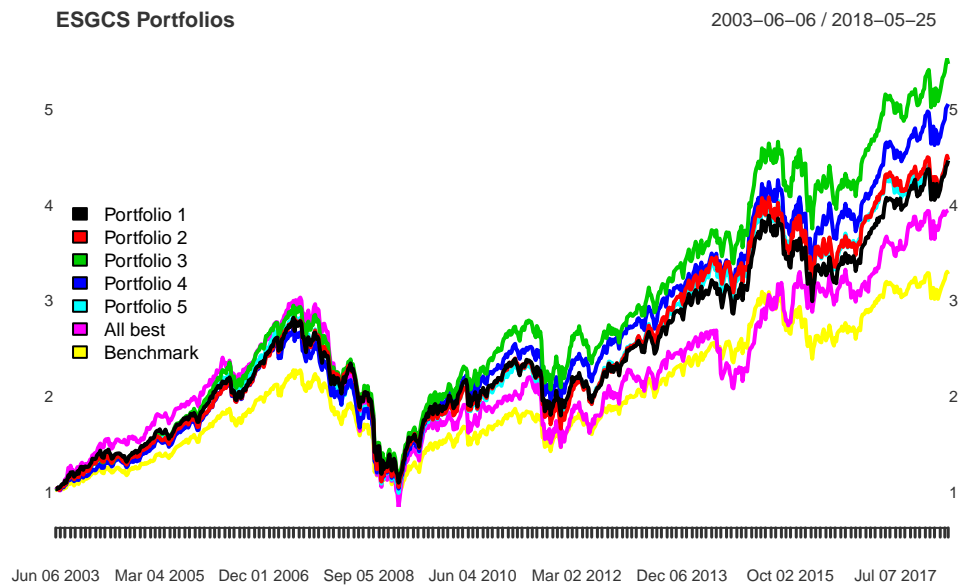
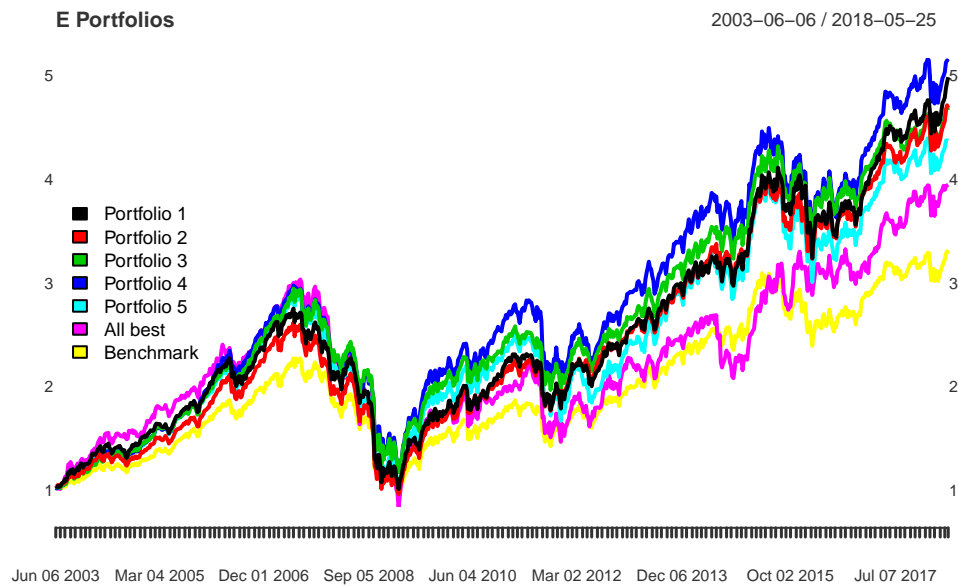Figure 25: Cumulative Returns of ESGCS Portfolios

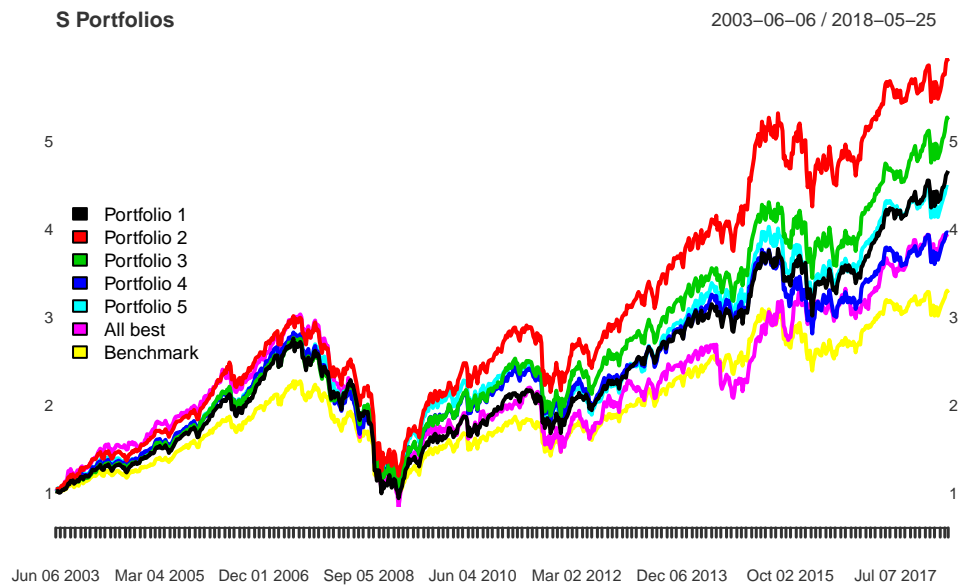Figure 26: Cumulative Returns of E Portfolios

Figure 27: Cumulative Returns of S Portfolios
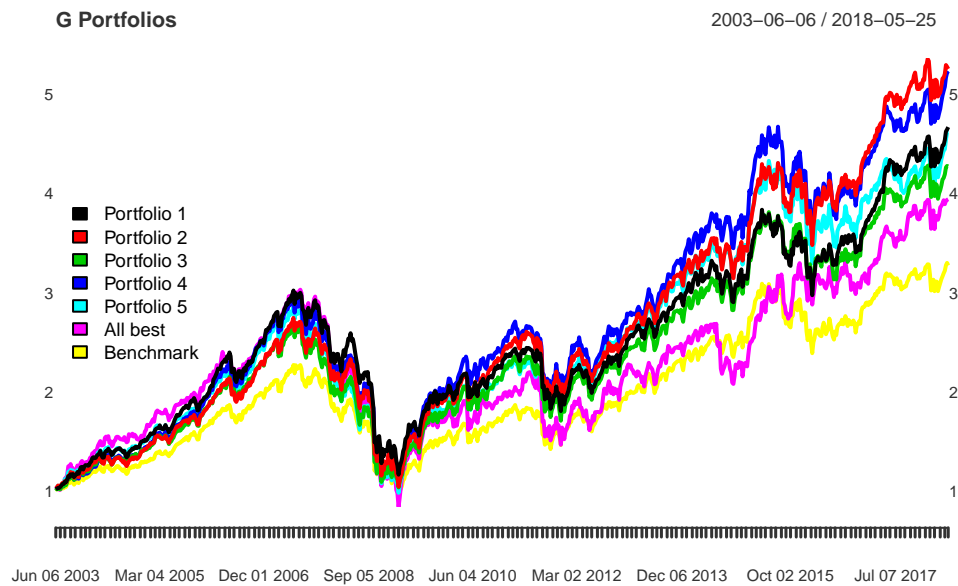
Figure 28: Cumulative Returns of G Portfolios
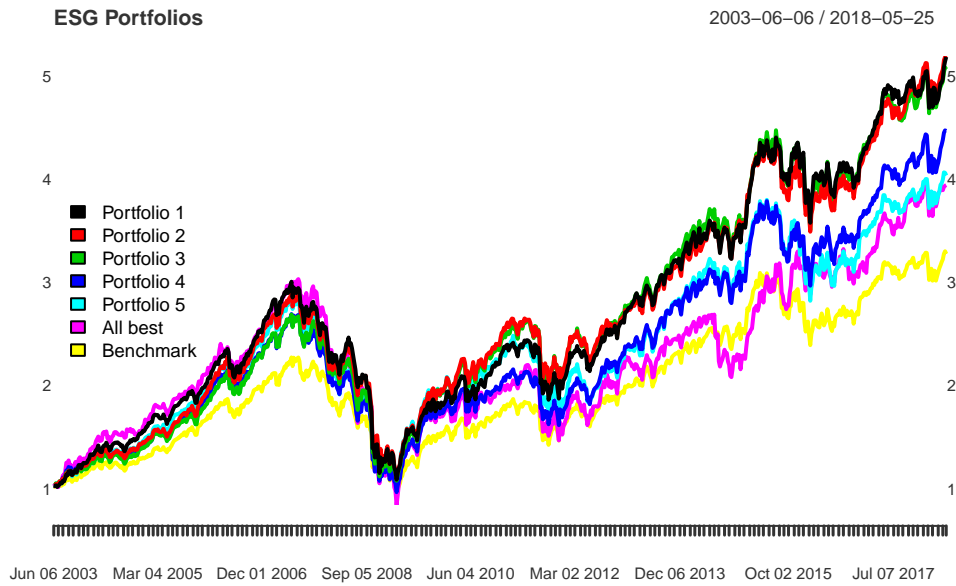
Figure 29: Cumulative Returns of ESG Portfolios
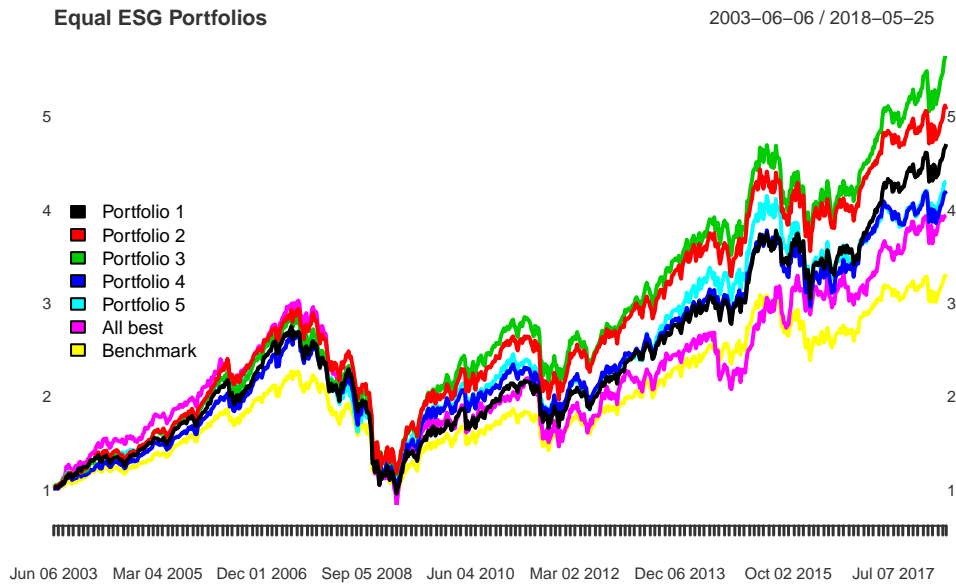
Figure 30: Cumulative Returns of Equal ESG Portfolios

Tables 35-37 show average annual return, annual standard deviation and Sharpe ratio for double-sorted portfolios. Based on average annual return, no patterns are defined. The portfolio 5 has the highest risk (except of ESGCS and G scores) and portfolio 1 has the lowest risk, measured with standard deviation. Portfolio 1 has greater Sharpe ratio than portfolio 5.

Table 35: Average Annual Return

|	esgcs	esg	e	s	g	equal_esg
Portfolio 1	11.75	12.7	12.45	12.02	11.94	12.03
Portfolio 2	11.96	12.68	12.08	13.73	12.86	12.61
Portfolio 3	13.16	12.72	12	12.97	11.53	13.39
Portfolio 4	12.66	11.91	12.85	11.08	13.15	11.49
Portfolio 5	11.89	11.41	12.04	11.95	12.25	11.83

Table 36: Annual Standard Deviation

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	18.66	18.37	18.49	18.55	18.04	18.25
Portfolio 2	19.65	18.45	18.74	19.28	18.76	18.7
Portfolio 3	18.96	19.37	18.43	19.43	19.01	19.21
Portfolio 4	19.12	19.44	19.59	19.32	20.54	19.61
Portfolio 5	19.49	20.37	20.83	19.61	20.08	20.29

Table 37: Sharpe Ratio

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.58	0.64	0.62	0.59	0.61	0.6
Portfolio 2	0.56	0.63	0.59	0.66	0.63	0.62
Portfolio 3	0.64	0.61	0.6	0.62	0.55	0.64
Portfolio 4	0.61	0.56	0.6	0.52	0.59	0.53
Portfolio 5	0.56	0.51	0.53	0.56	0.56	0.53

The table 38 contains statistics for the benchmark Stoxx Europe 600 index and the all-best portfolio. The all-best portfolio has the highest annual standard deviation and the lowest Sharpe ratio.

Table 38: Benchmark and All-Best Portfolio Statistics

	benchmark	all_best_portfolio
Average Annual Return	9.56	11.88
Annual Standard Deviation	17.88	23.1
Sharpe Ratio	0.48	0.47

Tables 39-42 illustrate average sustainability, size, value and momentum scores for constructed portfolios. We can see that portfolios differ significantly based on the average sustainability score, while they have almost the same average value and momentum scores. Regarding the average size score, portfolio 5 always has higher score than portfolio 1.

Table 39: Average Sustainability Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	31.61	38.05	27.76	29.93	18.52	31.8
Portfolio 2	41.86	52.68	58.65	62.37	42.9	57.92
Portfolio 3	50.21	61.08	77.22	78.2	61.57	70.75
Portfolio 4	60.75	68.46	87.97	88.08	75.22	79.7
Portfolio 5	71.67	76.86	92.52	93.69	86.08	86.93

Table 40: Average Size Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.0229	0.0171	0.0183	0.0184	0.0209	0.0185
Portfolio 2	0.0297	0.0217	0.0193	0.0234	0.025	0.0235
Portfolio 3	0.0252	0.0238	0.0277	0.0278	0.0266	0.0259
Portfolio 4	0.0223	0.0285	0.0277	0.0272	0.0271	0.0279
Portfolio 5	0.0247	0.0319	0.0302	0.0268	0.0243	0.0277

Table 41: Average Value Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.3773	0.3773	0.3781	0.3784	0.3768	0.3784
Portfolio 2	0.3769	0.3782	0.3782	0.3775	0.3772	0.378
Portfolio 3	0.3781	0.3778	0.377	0.3772	0.3783	0.3766
Portfolio 4	0.3772	0.3768	0.3768	0.3768	0.3768	0.3767
Portfolio 5	0.3769	0.3763	0.3763	0.3765	0.3772	0.3767

Table 42: Average Momentum Score

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.4139	0.415	0.4149	0.415	0.4142	0.4147
Portfolio 2	0.4133	0.4153	0.4147	0.4155	0.4143	0.4151
Portfolio 3	0.4148	0.4146	0.4141	0.4146	0.4137	0.4145
Portfolio 4	0.4143	0.4132	0.4142	0.413	0.4147	0.4133
Portfolio 5	0.4136	0.4122	0.412	0.4122	0.4134	0.4125

Tables 43-45 contain Market, Bull and Bear Market Betas for double-sorted portfolios. We observe that portfolio 5 has all betas higher than portfolio 1.

Table 43: Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	1.01	0.98	0.99	0.99	0.96	0.97
Portfolio 2	1.07	1	1.01	1.04	1.01	1.01
Portfolio 3	1.03	1.05	1	1.05	1.03	1.04
Portfolio 4	1.03	1.06	1.07	1.05	1.11	1.07
Portfolio 5	1.05	1.1	1.13	1.06	1.08	1.1

Table 44: Bull Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	0.98	0.95	0.97	0.95	0.91	0.93
Portfolio 2	1.08	0.99	1.01	1.08	0.98	1
Portfolio 3	1.05	1.06	1	1.05	1.04	1.05
Portfolio 4	1.04	1.07	1.09	1.05	1.15	1.1
Portfolio 5	1.06	1.14	1.15	1.08	1.14	1.14

Table 45: Bear Market Betas

	esgcs	esg	e	s	g	equal_esg
Portfolio 1	1	1.03	1.02	1.04	0.99	1.03
Portfolio 2	1.09	1.01	1.03	1.05	1.04	1.01
Portfolio 3	1.03	1.06	1.01	1.05	1.02	1.04
Portfolio 4	1.06	1.07	1.05	1.05	1.12	1.07
Portfolio 5	1.05	1.06	1.13	1.06	1.07	1.09

6. Discussion

We need to determine how many companies from index have E, S, G, ESG and ESGCS Datastream scores. The amount must be sufficient.

Firstly, we investigated how many companies from S&P 500 and Stoxx Europe 600 indices have E, S, G, ESG and ESGCS Datastream scores. We found out that for S&P 500 index this value lays in the range [377;505], while for Stoxx Europe 600 index it is in the interval [345;599]. These findings are sufficient to conduct the analysis for both American and European stock market.

Secondly, we examined the consistency of the scores by checking correlation between Sustainalytics ESG score and Datastream E, S, G, ESG, ESGCS and ESG Equal scores. For both American and European stock markets in all cases correlation is positive. For the S&P 500 index the highest correlation with the Sustainalytics ESG score is observed for Equal

ESG score and the lowest - for ESGCS score. For Stoxx Europe 600 the S score is mostly correlated with the Sustainalytics ESG score while ESGCS and G scores experience the lowest correlation.

Thirdly, we constructed portfolios for both S&P 500 and Stoxx Europe 600 constituents. We additionally applied sorting by size score. All used methodology was explained in Chapter 4. All constructed portfolios outperform the benchmarks. We analyzed cumulative returns of portfolios and received surprising results. In the American market "good" companies perform better (portfolio 5 and all-best portfolio are winners without and with size sorting) while for European market "good" companies perform worse(all-best portfolio is a looser without and with size sorting).

Additionally we calculated average annual return, standard deviation and Sharpe ratio. We got completely different results for American and European stock market. For S&P 500 stocks, as a rule, portfolio 5 has the highest Sharpe ratio and outperforms portfolio 1 in terms of annual return. Regarding standard deviation, portfolio 5 has the lowest risk and portfolio 1 has the highest risk. For Stoxx Europe 600 stocks, as a rule, portfolio 1 has higher Sharpe ratio than portfolio 5, portfolio 1 has the lowest risk and portfolio 5 has the highest risk. Based on average annual return no patterns were defined.

For both markets the benchmarks have the lowest both average annual return and annual standard deviation. For American stock market the all-best portfolio has the highest both average annual return and annual standard deviation in case of double-sorting. For European stock market the all-best portfolio has the highest annual standard deviation and the lowest Sharpe ratio in both cases.

Fourthly, we calculated average sustainability, size, value and momentum scores for constructed portfolios. We can see that portfolios differ significantly based on the average sustainability score, while they have almost the same average value and momentum scores. We discovered that "good" companies are usually detected among companies with high market capitalization. The opposite is true as well.

Finally, we calculated Market, Bull and Bear Market Betas for both American and European stock markets. The results are different for different markets. In USA portfolio 1 has all betas higher than portfolio 5. In Europe it is the opposite.

7. Conclusion

Proving or disproving the underperformance concerns of sustainable investment involves several important steps. We started from data download and preparation, providing reasonable data quality for the research. It is very important that we made our conclusions using sufficient amount of data.

We showed that Datastream sustainability scores are positively correlated with the Sustainanalytics ESG score. However, correlation differs significantly for various scores.

We constructed sustainability-scores-based portfolios for both American and European Stock Markets without and with size sorting. For these markets we received different, even opposite results. In the American market investing in "good" companies in terms of sustainability brings high return and low risk. For Europe this investment strategy is characterized with low return and high risk. In American market "good" stocks are less sensitive to all, positive and negative (separately) market movements. In European market it is opposite.

We discovered that sustainability scores positively are correlated with market capitalization.

The implementation required us to use a programming language that fits better our requirements of working with large amount of data. Such language, specially designed for data science purposes, is R. This tool allowed us to execute all required steps efficiently and professionally.

By the end of the research we were able to answer some of the hottest questions in the field and provide asset managers and individual investors with valuable information. The finding about opposite results in American and European Stock Markets can help to avoid biased or even incorrect investment decisions.

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